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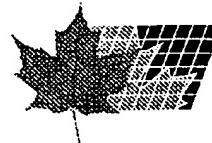
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- (54) DISPOSITIF POUR PRODUIRE DES PIECES EN MOUSSE MOULEE, PROCEDE PERMETTANT DE PRODUIRE UN OUTIL DE MOULAGE ET PROCEDE PERMETTANT DE PRODUIRE UNE PIECE EN MOUSSE MOULEE  
 (54) DEVICE FOR PRODUCING FOAMED SHAPED PARTS, METHOD FOR THE PRODUCTION OF A FORM TOOL AND METHOD FOR THE PRODUCTION OF A SHAPED FOAMED PARTED

(57)

The invention relates to a device for foaming foamed shaped parts in a form tool which can be opened and closed. Said tool is provided with a non-stick coating. The invention also relates to a method for the production of a form tool with a non-stick coating. Lastly, the invention relates to a method for producing a foamed shaped part. Foamed shaped parts stick to the form tools in which they are produced thereby making it difficult or even impossible to remove said parts therefrom. The invention provides a solution to this problem by creating a dense crystal-structure surface coating for said form tools. The molecules of the foaming systems are also excited by ionized air along the surfaces of said tools in such a way that the molecules cannot penetrate the crystal-structure coating. Molecular excitation of the foaming systems along the coating in the mold cavity occurs by means of a flat voltage potential which in turn obtains its impulsivity from the positive charged ionized gas that is blown in.



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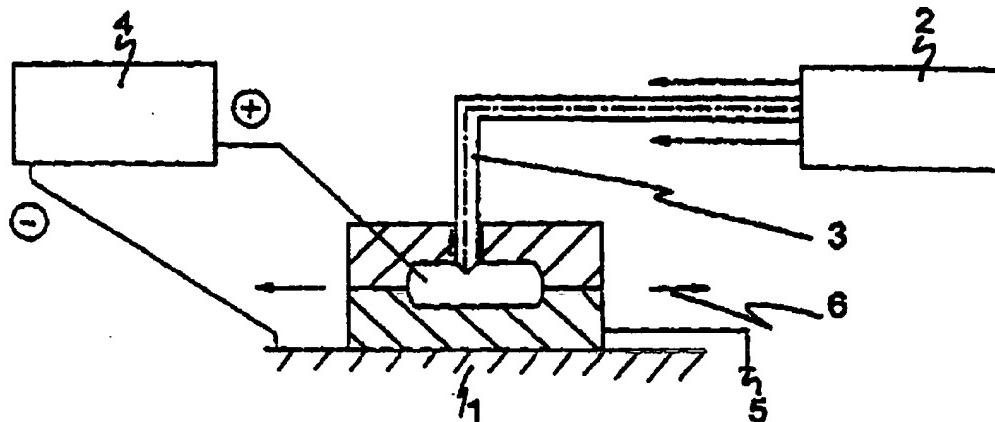
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(54) **DISPOSITIF POUR PRODUIRE DES PIÈCES EN MOUSSE MOULEE, PROCÉDÉ PERMETTANT DE PRODUIRE UN OUTIL DE MOULAGE ET PROCÉDÉ PERMETTANT DE PRODUIRE UNE PIÈCE EN MOUSSE MOULEE**

(54) **DEVICE FOR PRODUCING FOAMED SHAPED PARTS,  
METHOD FOR THE PRODUCTION OF A FORM TOOL AND  
METHOD FOR THE PRODUCTION OF A SHAPED FOAMED  
PARTED**



(57) L'invention concerne un dispositif permettant de faire mousser des pièces en mousse moulée dans un outil de moulage à ouvrir et à fermer, muni d'un revêtement anti-adhérent. L'invention concerne également un outil de moulage muni d'un revêtement anti-adhérent, ainsi qu'un procédé permettant de produire une pièce en mousse moulée. De manière générale, les pièces en mousse moulée adhèrent aux outils de moulage dans lesquels elles sont produites, ce qui rend leur extraction extrêmement difficile, voire impossible. Pour pallier cet inconvénient, il est prévu selon l'invention de réaliser un revêtement pour les outils de moulage, qui présente une

(57) The invention relates to a device for foaming foamed shaped parts in a form tool which can be opened and closed. Said tool is provided with a non-stick coating. The invention also relates to a method for the production of a form tool with a non-stick coating. Lastly, the invention relates to a method for producing a foamed shaped part. Foamed shaped parts stick to the form tools in which they are produced thereby making it difficult or even impossible to remove said parts therefrom. The invention provides a solution to this problem by creating a dense crystal-structure surface coating for said form tools. The molecules of the foaming systems are also





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structure cristalline très dense en surface. À cet effet, les molécules des systèmes de mousse sont excitées par de l'air ionisé le long de la surface de l'outil de moulage, de manière à les empêcher de pénétrer dans la structure cristalline. L'excitation moléculaire des systèmes de mousse le long du revêtement dans la cavité de moulage s'effectue à l'aide d'un potentiel de tension plate qui éprouve à nouveau son impulsivité par l'intermédiaire du gaz injecté sous forme ionisée, à charge positive.

excited by ionized air along the surfaces of said tools in such a way that the molecules cannot penetrate the crystal-structure coating. Molecular excitation of the foaming systems along the coating in the mold cavity occurs by means of a flat voltage potential which in turn obtains its impulsivity from the positive charged ionized gas that is blown in.



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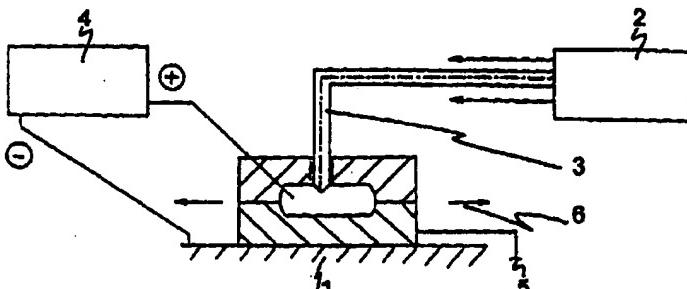
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(54) Title: DEVICE FOR PRODUCING FOAMED SHAPED PARTS, METHOD FOR THE PRODUCTION OF A FORM TOOL AND METHOD FOR THE PRODUCTION OF A SHAPED FOAMED PARTED

(54) Bezeichnung: VORRICHTUNG ZUM HERSTELLEN VON FORMSCHAUMTEILEN, VERFAHREN ZUM HERSTELLEN EINES FORMWERKZEUGES UND VERFAHREN ZUM HERSTELLEN EINES FORMSCHAUMTEILS

(57) Abstract

The invention relates to a device for foaming foamed shaped parts in a form tool which can be opened and closed. Said tool is provided with a non-stick coating. The invention also relates to a method for the production of a form tool with a non-stick coating. Lastly, the invention relates to a method for producing a foamed shaped part. Foamed shaped parts stick to the form tools in which they are produced thereby making it difficult or even impossible to remove said parts therefrom. The invention provides a solution to this problem by creating a dense crystal-structure surface coating for said form tools. The molecules of the foaming systems are also excited by ionized air along the surfaces of said tools in such a way that the molecules cannot penetrate the crystal-structure coating. Molecular excitation of the foaming systems along the coating in the mold cavity occurs by means of a flat voltage potential which in turn obtains its impulsivity from the positive charged ionized gas that is blown in.



(57) Zusammenfassung

Die Erfindung betrifft eine Vorrichtung zum Schäumen von Schaumformteilen in einem zu öffnenden und zu schließenden Formwerkzeug, welches mit einer Antihafbeschichtung versehen ist. Sie betrifft ebenfalls ein Verfahren zum Herstellen eines Formwerkzeuges mit einer Antihafbeschichtung. Schließlich betrifft die Erfindung auch ein Verfahren zum Herstellen eines Formschaumteils. Schaumformteile haften an den Formwerkzeugen, in denen sie hergestellt werden, wodurch sich die Entnahme der Formschaumteile stark erschwert bzw. unmöglich gemacht wird. Die Erfindung löst dieses Problem, indem eine Beschichtung für Formwerkzeuge geschaffen wird, die an der Oberfläche eine sehr dichte Kristallstruktur aufweist. Zudem werden die Moleküle der Schaumstoffsysteme durch ionisierte Luft entlang der Oberflächen des Formwerkzeuges so angeregt, daß sie nicht in die Kristallstruktur der Beschichtung eindringen können. Die Molekülregung der Schaumstoffsysteme entlang der Beschichtung in Formnest geschieht durch ein Flachspannungspotential, das wiederum seine Impulsivität durch das positiv geladene ionisierte Gas erfährt.

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**Process for producing a foam moulding, apparatus for  
foaming foam mouldings and process for producing a  
mould**

5           The invention relates to a process for producing a foam moulding in a mould as in the precharacterizing clause of Claim 1, to an apparatus for foaming foam mouldings in a mould which can be opened or closed as in the precharacterizing clause of Claim 8 and  
10          to a process for producing a mould of this type as in the precharacterizing clause of Claim 10.

Foam mouldings adhere to the moulds in which they are produced, and it is therefore extremely difficult or impossible to remove the foam mouldings.

15          There are various approaches for solving this problem, and these are described in brief below.

It is known from JP-A-62 044 410 that, following the shaping process, residues of plastic adhering to the surface of the outer side of a mould can be removed by blowing ionized air onto the surface so that static electricity, which is built up on the outer side of the mould, is neutralized, and the residues of plastic can then be removed with ease. However, no statement is made concerning any method for avoiding the adhesion of the  
20         foam moulding in the mould from the start.  
25

Furthermore, "Polyurethane" [Polyurethanes], Kunststoff Handbuch 7, 3rd edition 1993, pp. 362-363, Hanser Verlag, discloses chemical nickel-coating or other hard-coating of moulds to improve their surface quality.

30          It is also said that the use of moulds made of

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electroplate nickel with a backing of aluminium or of highly filled casting resins is limited due to the different expansion coefficients of the materials used. In "Taschenbuch für Galvanotechnik" [Electroplate Technology Handbook], Vol. 1, pp. 222-259, LPW, it is said that applying a sufficient thickness of intermediate coating made from extremely ductile semibright nickel before the actual hard chroming process can achieve better corrosion protection than that obtainable by the hard chroming process.

One more way of improving release performance is to add an internal release agent to the components for forming the foamed part. A procedure of this type is described, for example, in DE-C-38 37 351, where liquid polybutadiene is added to the polyol component and, respectively, to the polyamine component when producing articles made from polyurethane and, respectively, from polyurea. This procedure is also described in "Innere Trennmittel für Polyurethansysteme" [Internal Release Agents for Polyurethane Systems], P. Horn, H.-U. Schmidt and G. Ranlow, Kunststoffberater 19/1987, pp. 24-26.

As an alternative to this procedure, a release agent may also be applied to the surface of the mould. This procedure is described, for example, in DE-A-1 131 873, where an excess of substances reacting with isocyanate groups is applied to the mould when producing articles made from polyurethane foam. In DE-C-38 27 595, too, it is said that the internal walls of the mould used may, if desired, be treated/coated with known external mould-release agents to improve demoulding properties.

The disadvantages of using internal or external release agents are that these release agents are damaging to health and to the environment and increase the production costs for foam mouldings and also that the intro-

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duction or application of the release agents slows the production process. In addition, the release agents can affect the properties of the foam moulding. However, until now it has not been possible to dispense completely with release agents.

The object of the invention is therefore to provide a process and an apparatus for producing a foam moulding which enable a hard release layer to be provided and this to be excited in the simplest possible manner in order to rebuild the potential of the release layer for bringing about the ejection effect. Another object of the present invention is to provide a process for producing a mould with which the mould can be provided with a hard release layer which can be excited in the simplest possible manner.

The solution consists in a process for producing a foam moulding with the features of Claim 1, an apparatus for foaming a foam moulding with the features of Claim 5 and a process for producing a mould with the features of Claim 10.

Using the novel process for producing a foam moulding the potential of the release layer, and therefore the ejection effect, can be regenerated in a simple manner. The novel apparatus has a particularly hard release layer whose potential can easily be regenerated. Using the novel process to produce a mould, this hard release layer is obtainable in a simple manner. Other advantages of the invention are that it permits stable, controlled skin formation on the surface of the foam moulding. Since release agents can generally be dispensed with, no technical equipment, such as spray systems and exhaust systems or disposal systems, are needed. There are no residues of release agents on the surface of the foam mouldings. In addition, application time is saved, costs are eliminated, and there is generally less risk to

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people and the environment.

Advantageous embodiments are given in the subclaims. For example, the ionized gas mixture used may be positively charged air at from about 30 to 90°C which  
5 is injected into the mould at from about 4 to 6 bar. In addition, to facilitate charge transfer, either the gas or, respectively, the gas mixture, or the components for forming the foam moulding, can be enriched with a dielectric.

10 An advantageous embodiment of the novel apparatus provides that the electroplate layer is composed of chromium VI with traces of chromium III, ferrite and zinc. The thickness of the electroplate layer is preferably from 40 µm to 0.1 mm. The electroplate layer may advantageously have been applied to a chemical  
15 transition layer made from nickel with a proportion of from 1 to 15% of copper, where the thickness of the transition layer may be from 35 to 55 µm.

An advantageous embodiment of the novel process  
20 for producing a mould provides that, in the case of moulds made from plastic, an electrically conducting backing layer is first applied.

Working examples of the invention are described below using drawings.

- 25 Fig. 1 shows a diagram of a novel apparatus with a closed mould,  
Fig. 2 shows a diagram of a novel apparatus with an open mould,  
Fig. 3 shows a diagram of the ejection effect,  
30 Fig. 4 shows a diagram of the plot of electrode potential against time for a foaming procedure,

(continuation on page 5 of the documents originally submitted)

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~~Environmentally polluting cleaning of the foamed parts for further processing is also dispensed with.~~

5           The high surface hardness (about 1200 HV) of the coating and the mechanical loading, which is normally small, means that the coating has practically unlimited lifetime.

Working examples of the invention are described below using drawings.

10          Fig. 1    shows a diagram of a novel apparatus with a closed mould,

Fig. 2    shows a diagram of a novel apparatus with an open mould,

Fig. 3    shows a diagram of the ejection effect,

15          Fig. 4    shows a diagram of the plot of electrode potential against time for a foaming procedure,

Fig. 5    shows a diagram of the effect of the surface tension.

In Figs 1 and 2 there is a closed (Fig. 1) or 20 an open (Fig. 2) mould 1. An air-processing unit 2 for producing ionized gas, in this case ionized air, is attached to the mould 1 via an injection probe 3, so that ionized air and, if desired, also dielectric can be conducted into the mould 1 via the injection probe 3. The 25 positive pole of a high-voltage unit 4 is connected, in Fig. 1, to the interior of the mould 1, and in Fig. 2 to the end of the injection probe 3. The negative pole of the high-voltage unit 4 is earthed, and the mould 1 has in each case an earth 5. The mould of Fig. 1 also has ventilation arrangements 6. In the case of moulds made 30 from metallic materials, the coating according to the invention is applied as follows:

After cleaning the mould surface and, if necessary, smoothing the mould surface in the crystal range 35 or, respectively, in the micro range, which may be done by polishing, but without chemical polishes, the surface

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qualities are as follows:

- bright (mechanically polished without polishes)
- matt (electrolytically polished with subsequent glass-bead blasting)
- 5     ● a structure (electropolished).

The locations not to be coated on the article are then covered over with a specific surface-coating material.

10       The mould is then chemically or electro-chemically treated or - in particular if the silicon content of the mould is high - subjected to mechanical operations.

15       For example, a chemical transition layer made from nickel with a proportion of from 0 to 15% of copper is applied in an acid dip bath. The thickness of the chemical transition layer is preferably from about 35 to 55 µm.

20       An electroplate layer, which can also be termed a chemical service layer, is then applied to the transition layer in an acid bath, for example in a 2% strength sulphuric acid bath. The electroplate layer is preferably composed of chromium VI with traces of chromium III, ferrite at about 0.5% and zinc. It has an overall thickness of from about 40 µm to 0.1 mm. It may, 25       for example, be composed of three sublayers, where a grounding layer of about 30 µm is first applied by fluidization with low current density.

30       Onto this grounding layer a carrier layer of thickness from about 5 to 50 µm is applied, operating at a higher current density than for the base layer, but controlling the rate of crystallization by more rapid anode traverse. Finally, a finished service layer or vector layer is built up on the carrier layer by shifting the axis direction of the principal crystal structures or 35       zones in the range from 15 to 60° (orientation) with respect to the surface normal vector layer.

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The thickness of the vector layer is from 5 to 15 µm. It is applied, as a passivated final layer, by means of +/- polarity inversions and current density reduction, for which the following preconditions must 5 have been met:

- crystal structure microporous
- uniform layer thickness in the directions of the principal surface derivatives +/- 10 m
- the additional anode in the electroplate direction 10 must be dimensioned with regard to fluid dynamics (the electrode spacing of 12 mm must be maintained as a grid dimension for the lead network electrode).

The current density, voltage, direct current quality and electrolyte quality must, as for hard 15 chroming, be calculated as required by standards. Any residual crystals which may be present are then be removed by surface grinding and the mould can be assembled. A high surface hardness of about 1200 Vickers 20 is achieved, as a result of which the lifetime which can be achieved is practically unlimited.

In the case of moulds made from plastics (e.g. 25 epoxy resin) the procedure is in principle identical except that in this instance an electrically conducting backing layer is first applied to the mould and may be composed, for example, of epoxy lacquer or metal lacquer and have a thickness of, for example, 0.2 mm.

The coating features a very dense crystal structure at the surface. In addition, the molecules of the foam across the surfaces of the mould are excited so 30 that they cannot penetrate the crystal structure of the coating. This excitation must be maintained until as many as possible of the chemical reactions taking place during the foaming process have been concluded. Energy is dissipated via differing pH values and differing water 35 contents of the various foaming systems. The cause of this dissipation is the polyurethane molecules at the

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cavity wall which are set in vibration during the course of the chemical process for curing the polyurethane. This energy gradually dissipated in the mould during the chemical reactions must be continuously replaced if problems are to be avoided during the foaming operation.

A controllable "ejection effect" is achieved across the surface of the mould by means of surface tension. With a surface temperature of the mould of 25°C an electrode potential as low as -0.7 E volt in the initial phase including the injected air used is effective. To ensure easy demoulding of the foamed parts in mass production it is important that the E potential in the mould cavity is maintained.

The original potential of the coating in the mould cavity is mostly, though not necessarily, reduced after the first foaming procedure. This reduction represents a loss of energy.

If the loss reaches a certain level, the reduced energy must be supplemented to maintain the ejection effect.

Fig. 3 shows the function of the ejection effect and Fig. 4 shows the plot of the E potential against time for a foaming procedure, where each foaming procedure has been divided up into individual phases. In phase 1 (0-1 in Fig. 4) the liquid polyurethane components 7 are injected into a mould 1 with a coating 8, in phase 2 (1-2 in Fig. 4) the chemical process (the reaction) proceeds, in phase 3 (2-3 in Fig. 4) the foamed part 9 is removed and then (not shown in Fig. 3, 3-4 in Fig. 4) there is external supplementation of the E potential of the coating, e.g. by friction or by ionized air and the following definitions apply:

$$E_{\max} \text{ minus } E_1 = E_{\text{Loss}} \text{ or } E_L \text{ and } E_{\max} - E_{\min} = [A]$$

E<sub>1</sub>: electropotential after the first foaming procedure

$$E_1 \text{ minus } E_{\min} = E_{\text{reverse}} \text{ or } E_r; E_1 = E_r + E_{\min}$$

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$$E_L = E_{\max} - (E_r + E_{\min})$$

where

$E_{\min}$ : E potential dissipation by the chemical PU  
5 foam process

$E_r$ : E potential supplementation by part  
removal (internal E potential supplementa-  
tion)

therefore: if limit  $E_d(t) \gg A$  and  $E_d = [A] 2, 3$  or  
10  $E_r = E_{\max} - E_{\min}$ , then phase 3-4 is dispensed  
with

After the chemical reaction has proceeded it is  
possible to apply an electrostatic charge to the outer  
skin of the polyurethane part.

15 When the foamed part is demoulded a negative  
E potential is produced across the mould coating. This  
E potential in turn is transferred to the outer skin of  
the foamed part via the kinetic energy introduced when  
removing the part. Immediately after separation from the  
20 mould cavity coating the surface of the foamed part  
becomes positively charged and, in parallel, its negative  
E potential is supplemented by further separation from  
the coating.

25 It can be seen that the foamed part has a  
certain electrical charge during demoulding; however,  
with release agent this charge would be greater still  
(sparking).

It is also important to know that the E poten-  
30 tial operations only take account of those components  
which affect the so-called surface tensions. These  
operators are always the derivatives for which the  
direction of the normal vector runs parallel to and in  
the opposite direction to the principal direction in the  
chemical reaction of the polyurethane content. This  
35 particular direction is mostly towards the centre of  
gravity of the part.

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According to Poisson, the potential relationship can described by:

$$E_{\max} = E u_{\max}$$

5

Eu here then  $\underline{U}(r)$  as potential

$\underline{V}(r)$  = the vector layer in the mould cavity

10 and so

$$V_x = \frac{\partial u}{\partial x}, V_y = \frac{\partial u}{\partial y}, V_z = \frac{\partial u}{\partial z}, \rightarrow U(r) \text{ potentia}$$

15 for  $\underline{V}(r)$

$$V dr = (\text{grad } U) dr - dU$$

and so

20

$$V dr = dU = U(b) - U(a), \text{ if } a = a(r_0) \text{ and } b = b(r) \\ a \rightarrow b \quad a \rightarrow b$$

25

$$\text{then } U(r) - U(r_0) = V dr \rightarrow U(r) = U(r_0) + V dr \\ r_0 \qquad \qquad \qquad r$$

Simplified for a straight line:

30

$$U(x, y, z) = [U(x_0, y_0, z_0) + V_x(x_0, y_0, z_0) dy + V_y(x, y_0, z_0) dy + V_z(x, y, z_0) dz] * (-1) \\ x_0 \qquad \qquad \qquad y_0 \qquad \qquad \qquad z_0$$

35

The surface tension in this case is given in  
N/m.

Only a two-dimensional surface tension is

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therefore accepted across the mould coating.

The  $U(x, y, z)$  E potential (volt) therefore acts as the engine driving the surface tension between mould cavity coating and polyurethane content (about 0.03 N/m), as, for example, between mercury and oil, as a result of which this value gives expression to a defined separation. In this instance the mercury represents the mould coating and the oil represents the polyurethane system. The electrophysical parameters may therefore readily be compared.

$$\text{Thus } e = \frac{U(x, y, z) * P}{xyzV(x, y, z)} = \frac{E_{\max} * P}{V} \rightarrow E_{\max} = \frac{e * V}{P}$$

15

Explanation:

e: surface tension (N/m)

$U(x, y, z)$ : E potential - in this case  $E_{\max}$  volt or

20

$$\frac{\text{kg} * \text{qm}}{\text{A} * \text{sec}^3}$$

P: electrical dipole moment [ $\text{m} * \text{A} * \text{sec}$ ]

V(x, y, z) volume of the space enclosed by the coating  
25 (m<sup>3</sup>)

For P, dielectric is used

Values for P: - A: not more than 30 [ $\mu\text{A}$ ] (microampere parameter value tested and determined in the foaming experiments)  
30 - m: about 0.5 [m]  
- sec: about 5-39 [sec]

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The effect of the surface tension is shown in Fig. 5. Here a test fluid 10 which is the same in each case, e.g. oil, is shown on a coating 8 according to the invention with a different E potential, specifically at 5 a.) Emax, b.) E1 and c.) Emin. Droplet formation at Emax here is clearly recognizable and reduces as E potential also reduces.

Ways of re-exciting the E potential are described below.

10 The first way is to remove the electroplate layer by pickling and then to electroplate again, but this entails very high costs. The objective is to produce Emax again.

15 A second way is to abraid the electroplate layer mechanically with a rotating disc and lubricant, using, for example, a rotating disc made from a textile or a pelt (E1 potential is built up to Emax by kinetic energy). The abrasion frequency depends on the extent of the energy dissipation described above. Although the 20 material cost for this method is only low, the method is difficult to automate and therefore requires manpower.

A third way is to re-excite the surface of the mould using ionized gases or gas mixtures, in particular ionized air. Ionized air can be produced in a high-voltage system in which air is, for example, positively charged on flowing through a 50 kV high-voltage system and is heated to about 30 to 90°C. The air treated in this way is applied to the mould or, respectively, to its surface at from about 4 to 6 bar prior to foam injection. 25 To facilitate the build-up of potential in the mould cavity, the air may be enriched with a dielectric (e.g. vegetable-based, such as paraffin oil or castor oil, or else silicone oil) at a strength of about 3%. This procedure can be readily and completely automated, entails 30 low energy consumption and gives easy removal of the part. The only disadvantage is the need for installation 35

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into the foaming system.

$$E_{\text{system}} \geq E_{\text{Loss}}$$

5           The ionized gas and, respectively, in this case the ionized air are injected into the mould for from about 3 to 30 seconds, depending on the size of the mould, and this has to take place after about every third shot.

10          A fourth way is to mix the dielectric directly into the A component of the foam system, e.g. into the A component of a polyurethane system, as a constituent of the formulation. The admixing, limited to not more than 8%, reduces or stops the dissipation of energy by inhibiting charge transfer between mould and surface of 15         the foamed part, and increases Ez. For problem-free operation, from 90 to 95% of the charge transfer has to be prevented. Application is very easy, but low pH values and high water contents in the foam systems reduce the effectiveness of the dielectric agents. The physical 20         properties of the foam moulding may be impaired.

25          The very dense crystal structure of the coating and the excitation of the surface of the mould effectively prevent penetration of the foam components into the surface of the mould and any crosslinking which may take place there. Removal of the foam mouldings therefore poses no problems. The reacting PU molecules slide over the "microgrooves" of the crystal structure of the coating surface.

30          The present invention is particularly suitable for use when producing polyurethane foam mouldings with any of the currently known foam systems, such as RIM, integral, flexible or rigid foam mouldings. The invention may also be used wherever the reacting media used have a tendency to bind homogeneously to a contact surface (e.g. 35         chipboard production, etc.).

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**NEW PATENT CLAIMS**

1. Process for producing a foam moulding from foam components in a mould, where a mould is used whose shaping surfaces have a release coating in the form of a chrome-based electroplate layer, which has been applied to a chemical transition layer, with the following steps:
  - a stream of an ionized gas or gas mixture is produced and, prior to introduction of the foam components, injected into the mould;
  - the reaction process leading to the foam moulding is carried out in the mould;
  - the finished foam moulding is removed.
2. Process according to Claim 1, characterized in that the ionized gas mixture used is positively charged air at from about 30 to 90°C which is injected into the mould at from about 4 to 6 bar.
3. Process according to Claim 1 or 2, characterized in that, to facilitate charge transfer, the gas or the gas mixture is enriched with a dielectric.
4. Process according to Claim 1 or 2, characterized in that, to facilitate charge transfer, the components for forming the foam moulding are enriched with a dielectric.
5. Process for producing a mould for an apparatus for foaming foam mouldings in a mould which can be opened or closed, where the shaping surfaces of the mould have a release coating in the form of a chrome-based electroplate layer, characterized by the following steps:
  - cleaning and smoothing the surface of the mould,

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- using a specific surface-coating material to cover over the locations not to be coated on the article;
- applying a chemical transition layer made from nickel with a proportion of from 1 to 15% of copper,  
5 in a dip bath
- applying an electroplate layer made from chromium VI with traces of chromium III, ferrite and zinc, in a dip bath, where
  - a grounding layer is first applied by misting with a low current density,
  - then a carrier layer is applied by fluidization with a higher current density than for the grounding layer, where the rate of crystallization is controlled by relatively rapid anode  
10 traverse,
  - and finally a vector layer in the form of a passivated final layer is applied by shifting the axis direction of the principal crystal structures or zones in the range from 15 to 60°  
15 (orientation) with respect to the surface normal vector layer by means of +/- polarity inversions and current density reduction;
  - if desired, grinding the surface to remove residual crystals.
- 25 6. Process according to Claim 5, characterized in that, in the case of moulds made from plastic, an electrically conducting backing layer is applied first.
- 7. Apparatus for foaming foam mouldings in a mould which can be opened or closed, where the shaping surfaces  
30 of the mould have a release coating in the form of a chrome-based electroplate layer, characterized in that the electroplate layer is obtainable according to the process of one of Claims 5 and 6 and that there are means of producing a stream of an ionized gas or gas mixtures

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and means of injecting the gas or gas mixture into the mould.

8. Process according to Claim 7, characterized in that the thickness of the electroplate layer is from  
5 40 µm to 0.1 mm.

9. Process according to Claim 7 or 8, characterized in that the thickness of the chemical transition layer is from 35 to 55 µm.

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Fig. 1

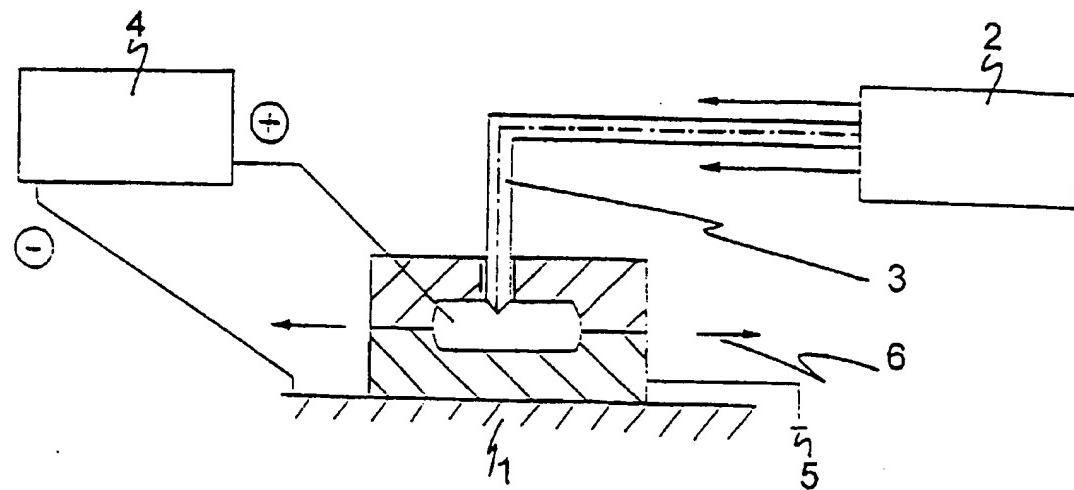
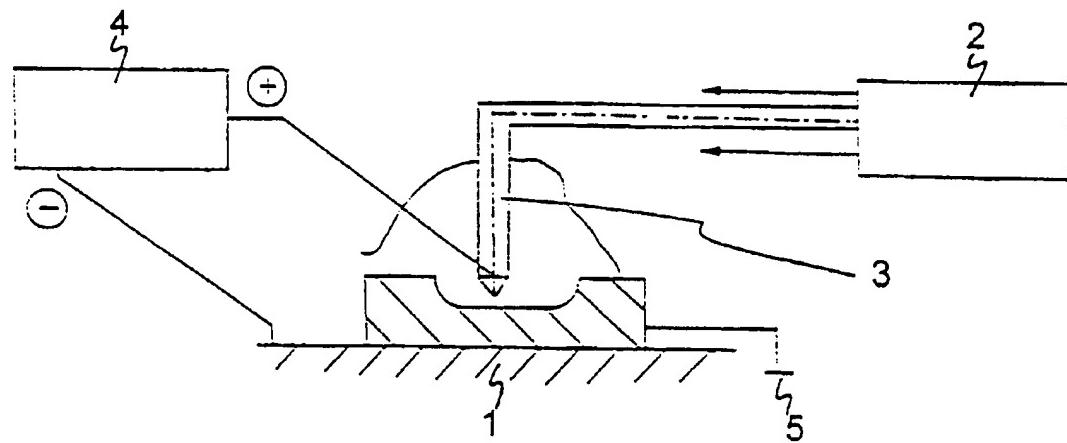


Fig. 2



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Fig. 3

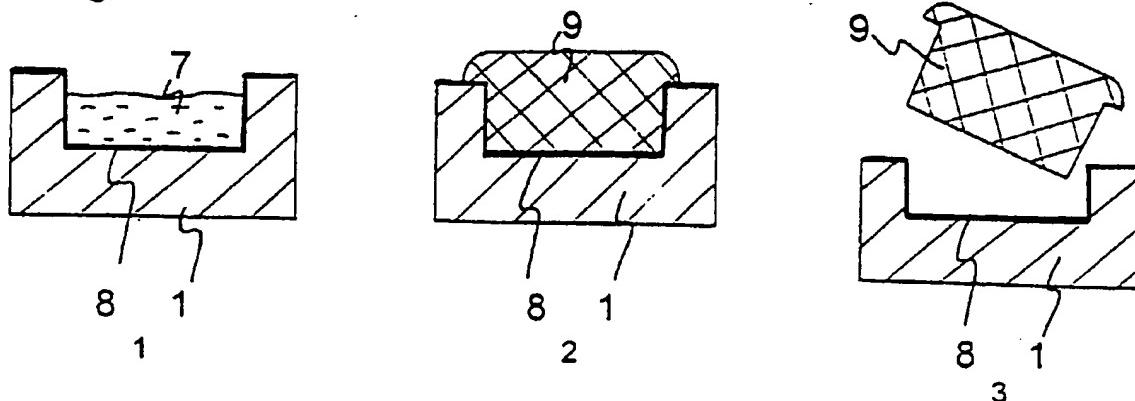


Fig. 4

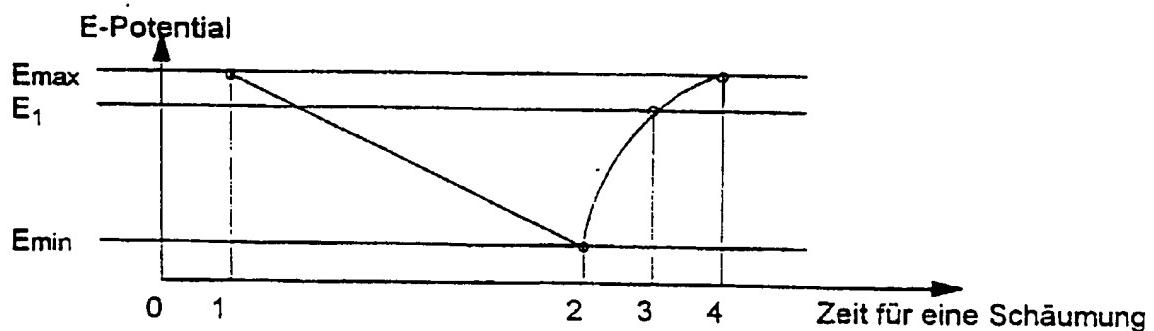
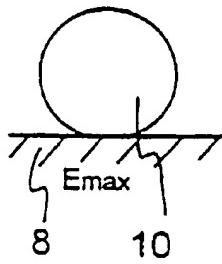
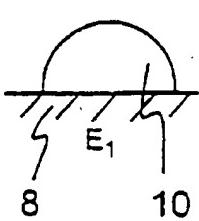


Fig. 5

a)



b)



c)

